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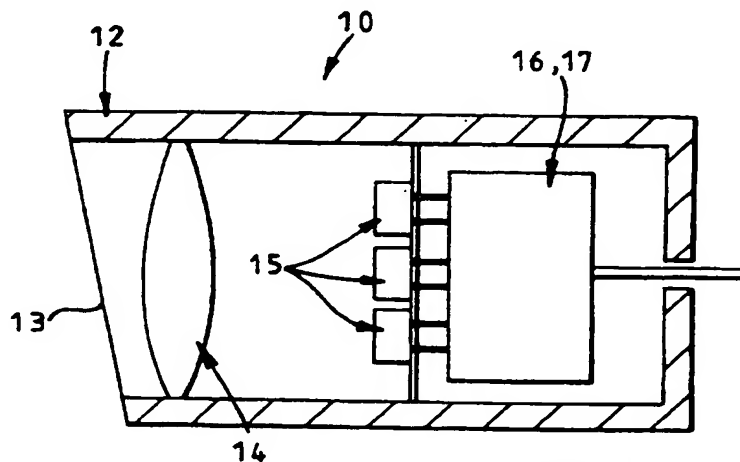
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(56) Documents Cited  
**GB 2285683 A**    **GB 2210453 A**    **GB 1502349 A**  
**GB 1412784 A**    **US 5055685 A**    **US 5012099 A**

(58) Field of Search  
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INT CL<sup>6</sup> **G08B 13/19 13/193 , G08G 1/00 1/005 1/01**  
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(54) Abstract Title  
**Apparatus for detecting the emission of infrared radiation**

(57) Apparatus for detecting the emission of infra-red radiation eg from pedestrians waiting at a pedestrian crossing, comprises optical means such as a lens 14 for projecting an image of a three-dimensional zone to be detected into the apparatus, an array of heat sensors 15 within the apparatus for detecting the emission of infra-red radiation from each of a plurality of sub-zones of the zone to be detected, and electronic circuit means 16, 17 responsive to the outputs of the sensors 15 for producing a signal indicative of the presence and/or absence of an infra-red emitter significantly different from the level of background infra-red emission from the detected zone. The sensors may be thermopiles and their output used to control traffic lights.



**FIG 1**

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

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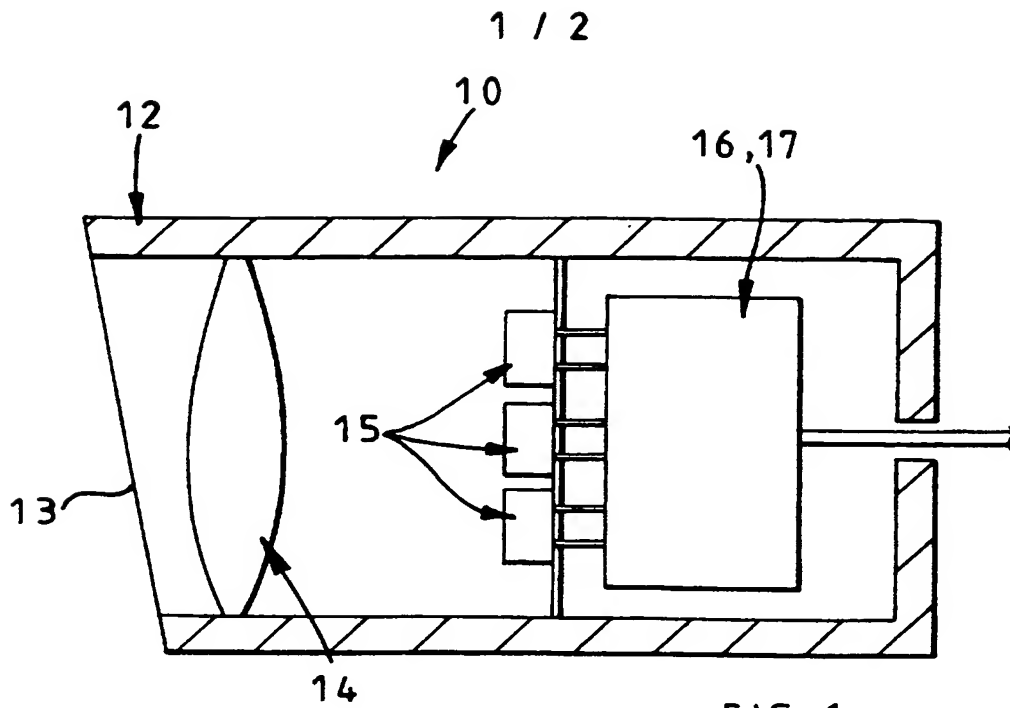


FIG 1

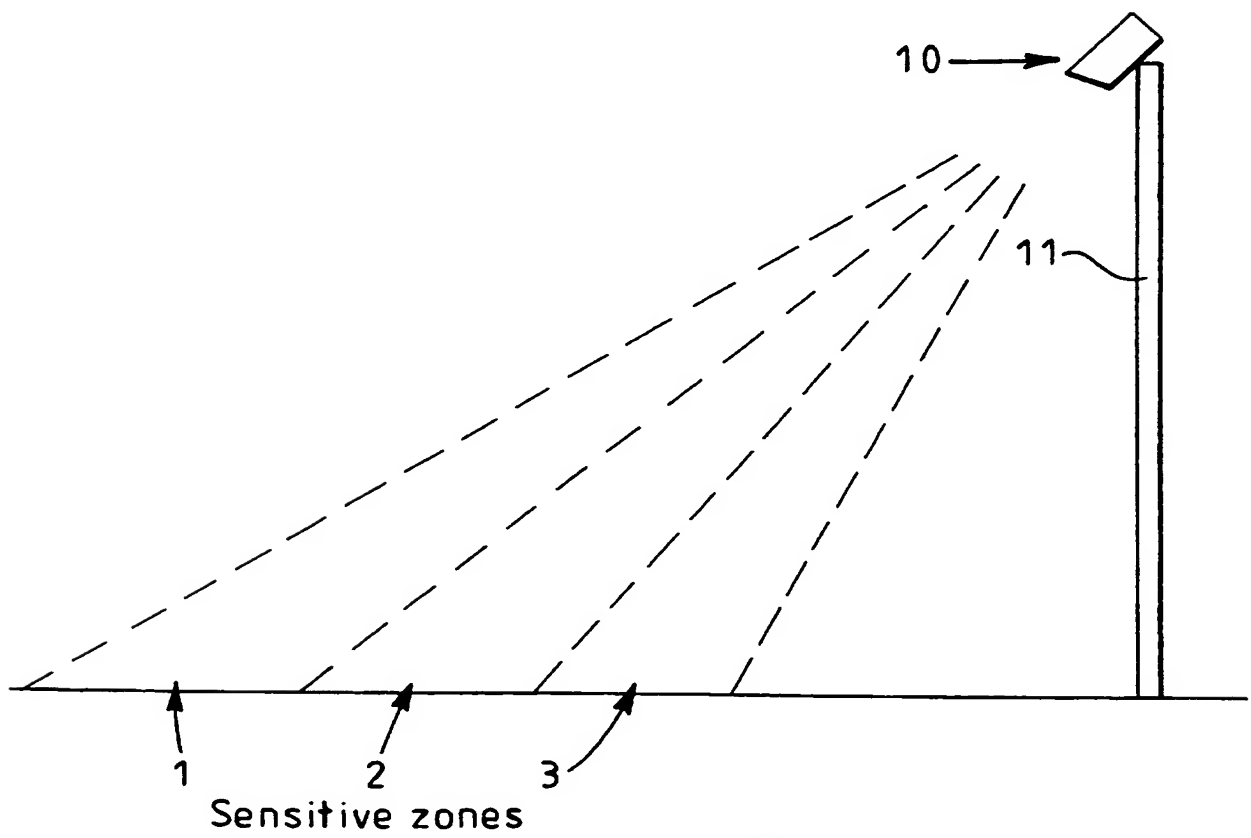


FIG 2

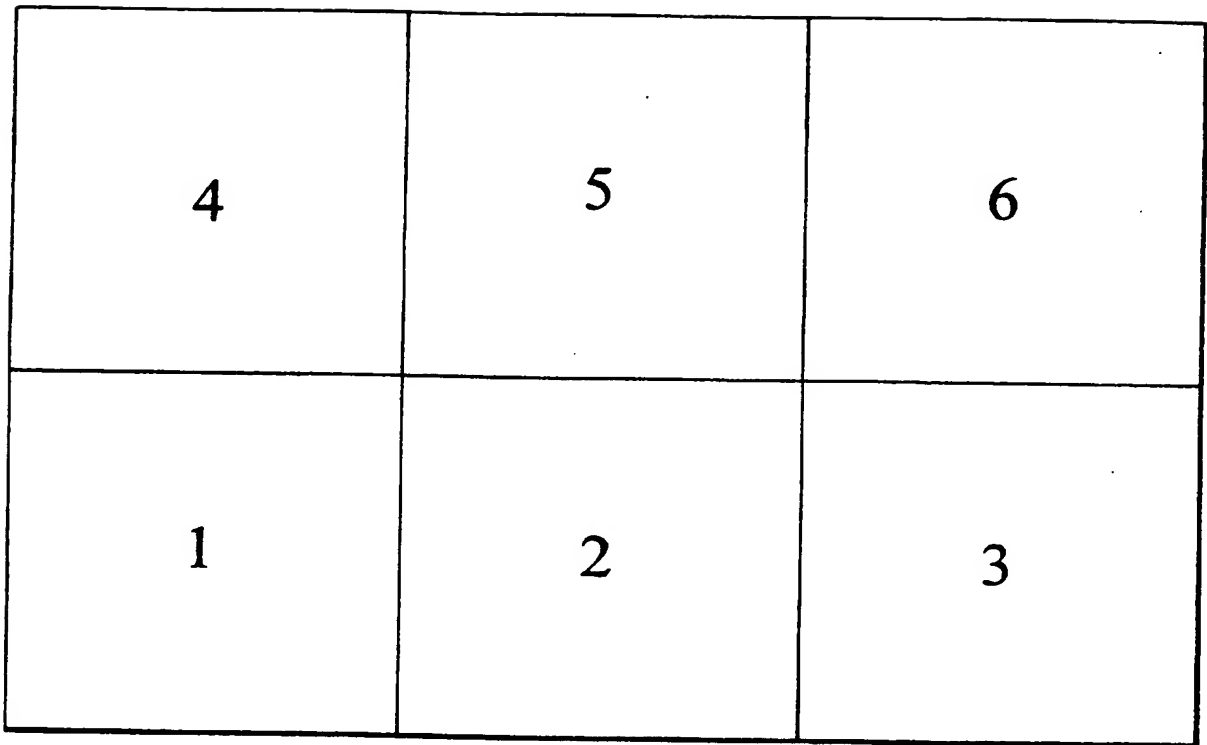


FIG 3

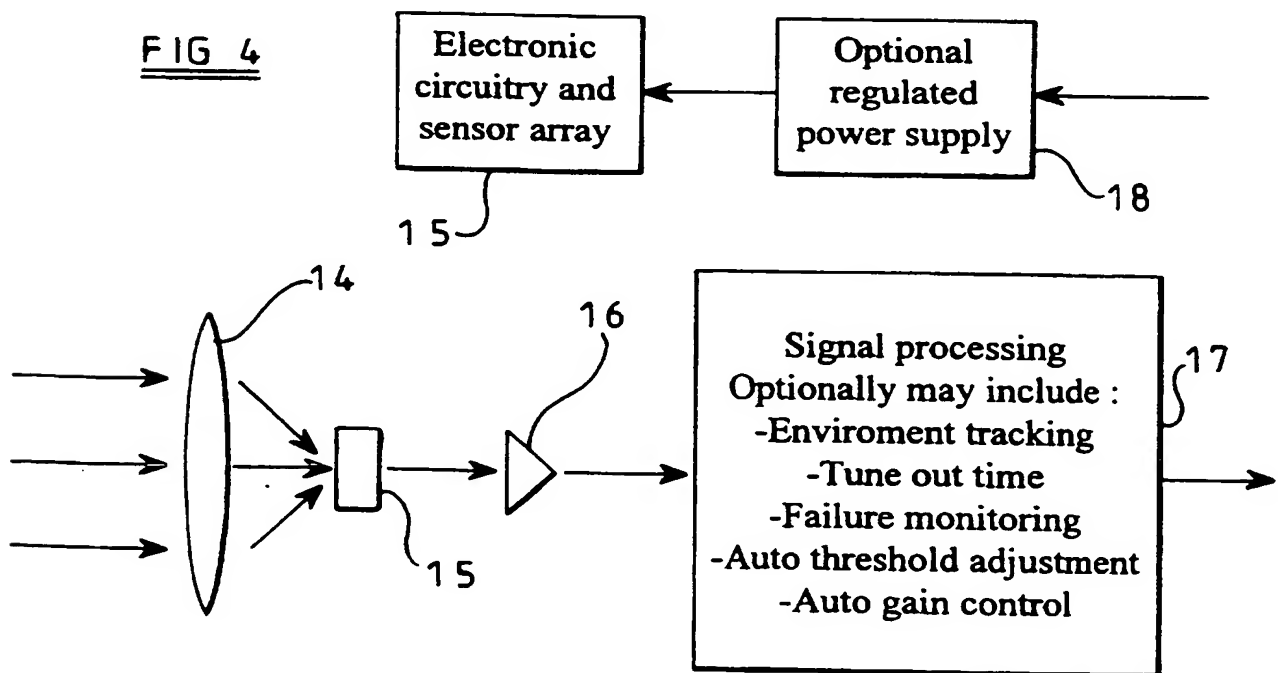


FIG 4

APPARATUS FOR DETECTING  
THE EMISSION OF  
INFRA-RED RADIATION

5           This invention relates to apparatus for detecting the emission of infra-red radiation, particularly but not exclusively from pedestrians waiting to cross a road at a pedestrian crossing controlled by traffic lights.

10           It is considered important to detect whether pedestrians are waiting at a pedestrian crossing controlled by traffic lights so as to avoid halting vehicles unnecessarily if persons, who initially indicate their intention to cross the road, have a change of mind and leave the waiting area adjacent to the roadside. At present it is known to implant pressure sensitive pads in the ground below the waiting area. However, these pads are expensive to install and installation of these pads causes  
15 surface damage. Also the pads must remain flat as otherwise they can become distorted and produce error signals.

          It is known to use active infra-red radiation to detect the presence of pedestrians but there is a risk of false readings particularly in adverse weather  
20 conditions.

          According to a first aspect of the present invention there is provided apparatus for detecting the emission of infra-red radiation, comprising optical means for projecting an image of a three-dimensional zone to be detected into the apparatus,

an array of heat sensors within the apparatus for detecting the emission of infra-red radiation from each of a plurality of sub-zones of the zone to be detected and electronic circuit means responsive to the outputs of the sensors for producing a signal indicative of the presence and/or absence of an infra-red emitter significantly different  
5 from the level of background infra-red emission from the detected zone.

Preferably, the optical means is arranged to project the image of the three dimensional zone to be detected onto one or more two dimensional planes within the apparatus and the heat sensors are arranged in or adjacent to said plane or planes.  
10

Preferably, the heat sensors are thermopiles. Alternatively, the heat sensors could be multiple thermocouples.

Preferably, the optical means comprises at least one lens. Alternatively or  
15 additionally, the optical means may comprise at least one mirror.

The optical means may include one or more filters so that only electromagnetic radiation of desired frequencies reaches the sensors.

20 The apparatus is ideally suited to detecting the presence and/or absence of pedestrians waiting to cross a road at a pedestrian crossing controlled by traffic lights, but it could also be used to detect the presence and/or absence of people in an entry system of a building or the presence and/or absence of a vehicle in a waiting zone. Other targets could be detected provided the combined effect of the temperature and

emissivity of the target provide a contrast with the background.

According to a second aspect of the invention there is provided a method of detecting the emission of infra-red radiation from pedestrians waiting to cross a road at a pedestrian crossing controlled by traffic lights, comprising the step of  
5 mounting detecting apparatus according to the first aspect of the invention at an elevated position above a pedestrian waiting area.

The invention will now be more particularly described, by way of example,  
10 with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of one embodiment of detecting apparatus according to the invention,

15 Figure 2 is an elevational view showing the detecting apparatus mounted at an elevated position adjacent to a pedestrian waiting area,

Figure 3 shows a projection of an image of the three dimensional zone onto a plane, and

20 Figure 4 is a schematic block diagram of the detector shown in Figure 1.

Referring to the drawings, the detecting apparatus 10 shown therein is intended for detecting the emission of infra-red radiation from pedestrians waiting to cross a road at a pedestrian crossing controlled by traffic lights.

The detecting apparatus 10 is mounted at an elevated position (as shown in Figure 2), such as on a pole 11 on which traffic lights (not shown) are mounted, and faces downwards towards the ground at an oblique angle. However, an extension arm could be attached to the pole 11 so that the detecting apparatus 10 can face vertically downwards.

The detecting apparatus comprises a housing 12 having an opening 13 at one end. A lens 14 is provided within the housing 12 adjacent to the opening 13 for projecting an image of the three dimensional waiting zone onto a two dimensional plane. An array of heat sensors 15 is arranged in or adjacent to said plane for detecting infra-red radiation emitted from each of a plurality of sub-zones 1 - 6 of the zone to be detected. The heat sensors 15 are in the form of thermopiles and each thermopile senses the infra-red emission from a respective sub-zone 1 - 6. The sensors 15 do not need to be mounted in the same plane. Some of the sensors 15 could be mounted in front of the two dimensional plane and some could be mounted behind the plane.

As shown in Figure 3, the sub-zones 1 - 6 are arranged side-by-side but they may be separated and/or may overlap and may be of any shape. Also, there may be more or less than six sub-zones.

As shown in Figure 4, the output signals of the heat sensors 15 are amplified by an amplification system 16 and are then processed by a microprocessor 17.

Power is supplied to the amplification system 16, the microprocessor 17 and the sensor array by a regulated power supply 18.

The microprocessor 17 analyses the outputs from the sensors 15 and detects the presence (and/or absence) of a pedestrian in the waiting area by noting a significant change in the level of infra-red emission from one or more of the sub-zones 1 - 6 by comparison with the level of background infra-red emission from the other sub-zones and/or a previous background value from that sub-zone.

A pedestrian waiting to cross the road will approach the waiting area and may indicate his/her intention to cross by depressing a button on a control panel for the traffic lights. Alternatively, the pedestrian may trigger an above or in ground detector. The control system of the traffic lights will then impose a delay before changing the lights to halt traffic and this delay may vary according to the length of time since traffic was last halted and/or whether vehicular traffic is currently present. If at the end of the delay period the detecting apparatus 10 indicates that no pedestrian is waiting to cross the road, which may be the case if the pedestrian has had a change of mind, the control system will not change the lights to halt the traffic. This will result in a reduction in delays to vehicles travelling along the road and enhance the credibility of light controlled crossings in the minds of all drivers.

The microprocessor 17 may include one or more of the following optional features:



- (i) Environmental tracking. Environmental changes such as changes in air temperature or sunlight levels will give rise to changes in the detector element outputs. These changes are generally rather slow and must not be taken as real detection signals.

5

- (ii) Tune out time. If one or more of the sub zones has a stationary object placed in it then it will be detected, but after a set period of time, it can be arranged that the signal from the stationary object is to be taken as part of a new background level and the detection state is terminated.

10

- (iii) Failure monitoring. The equipment may fail. If there are no detections for a set period of time (e.g. 24 hours), this could be used as an indication of equipment failure and a continuous detection output could be returned as a signal that investigation is required.

15

- (iv) Auto threshold adjustment. Each sensor may have a different output from its neighbours and, in this case, detection thresholds will need to be set separately for each sensor automatically.

20

- (v) Auto gain control. This will help (iv) above and will allow the detection apparatus to cope with situations where there are small signals perhaps in summer, and large signals perhaps in winter.

The detecting apparatus 10 operates on a passive infra-red system which will be less prone to giving false readings particularly in adverse weather conditions than an active infra-red system.

5           If desired, one or more filters may be provided so that only electromagnetic radiation of desired frequencies reaches the sensors 15. Typically, the filter(s) allow energy in the mid infra-red band (8-12  $\mu\text{m}$  approximately) to be received.

10           The image of the three dimensional waiting zone need not necessarily be projected onto a single two dimensional plane. It could instead be projected onto two or more planes within the housing 12.

          Also, the lens 14 could be replaced by one or more mirrors or by a lens and  
15   mirror system.

CLAIMS

1. Apparatus for detecting the emission of infra-red radiation, comprising optical means for projecting an image of a three-dimensional zone to be detected into the apparatus, an array of heat sensors within the apparatus for detecting the emission of infra-red radiation from each of a plurality of sub-zones of the zone to be detected and electronic circuit means responsive to the outputs of the sensors for producing a signal indicative of the presence and/or absence of an infra-red emitter significantly different from the level of background infra-red emission from the detected zone.

2. Apparatus as claimed in claim 1, wherein the optical means is arranged to project the image of the three dimensional zone to be detected onto one or more two dimensional planes within the apparatus and the heat sensors are arranged in or adjacent to said plane or planes.

3. Apparatus as claimed in claim 1 or 2, wherein the heat sensors are thermopiles.

4. Apparatus as claimed in claim 1 or 2, wherein the heat sensors are multiple thermocouples.

5. Apparatus as claimed in any one of the preceding claims, wherein the optical means comprises at least one lens.

6. Apparatus as claimed in any one of the preceding claims, wherein the optical means comprises at least one mirror.

7. Apparatus as claimed in any one of the preceding claims, wherein the optical means includes one or more filters so that only electromagnetic radiation of desired frequencies reaches the sensors.

8. Apparatus for detecting the emission of infra-red radiation, substantially as hereinbefore described with reference to the accompanying drawings.

10

9. A method of detecting the emission of infra-red radiation from pedestrians waiting to cross a road at a pedestrian crossing controlled by traffic lights, comprising the step of mounting detecting apparatus according to any one of the preceding claims at an elevated position above a pedestrian waiting area.



Application No: GB 9703399.7  
Claims searched: All

Examiner: Bob Clark  
Date of search: 5 January 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G1A (AMQH, AMZ)

Int Cl (Ed.6): G08B 13/19, 13/193; G08G 1/00, 1/005, 1/01, 1/04, 1/07

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X, Y	GB 2285683 A (GOLDSTAR) Page 8	X: 1,2,5,7 Y: 9
X, Y	GB 2210453 A (MATSUSHITA) Pages 9 and 10	X: 1 - 6 Y: 9
Y	GB 1502349 (ERNST LEITZ) Lines 1 to 56 on page 3	9
X, Y	GB 1412784 (BARNES) Whole document	X: 1 - 7 Y: 9
X, Y	US 5055685 (SUGIMOTO et al.) Column 5	X: 1 - 7 Y: 9
X, Y	US 5012099 (PATUREL et al) Lines 21 to 62 in column 3	X: 1,2,5,7 Y: 9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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